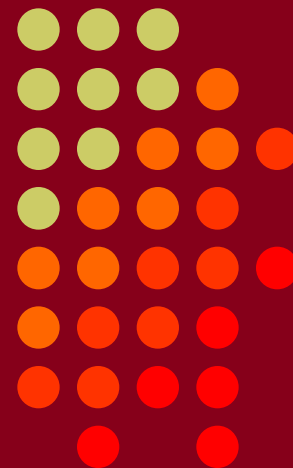


CTU 2015 Presents

RTTY Contesting Technology Topics

Ed Muns, W0YK



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RTTY Contesting

Technology Topics



- Transmitting AFSK vs. FSK
 - Which is “best”?
 - Bandwidth
 - FSK creation and inaccuracies
- Receiving Decoders
 - IF bandwidth
 - Multiple decoders
- Interfaces
 - Homebrew
 - Commercial

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RTTY vs. CW/SSB

Key Difference



Signal encoding/decoding:

- By technology
vs.
- By human brain

Kinda' like Assisted vs. Unassisted!

(Accordingly, what does the “Assisted RTTY” operator really DO?!)

RTTY vs. CW/SSB

Key Difference



Technology exploitation replaces *operating skill* in encoding/decoding the RTTY signal.

- *The 2 cornerstones of ham radio!*
- *RTTY technology is very important.*

What is RTTY?

compared to CW



CW

- **One** RF carrier
- Local audio **pitch**
- On **or** off
 - key up is data 0
 - key down is data 1
- **Morse** code
 - typically 25-40 wpm

RTTY

- **Two** RF carriers 170 Hz apart (*Space & Mark; Shift*)
- Local audio **tones**
- One on **and** other off
 - Space is data 0
 - Mark is data 1
- **Baudot** code
 - constant 60 wpm (*or 45.45 Baud*)

RTTY Transmission

AFSK vs. FSK



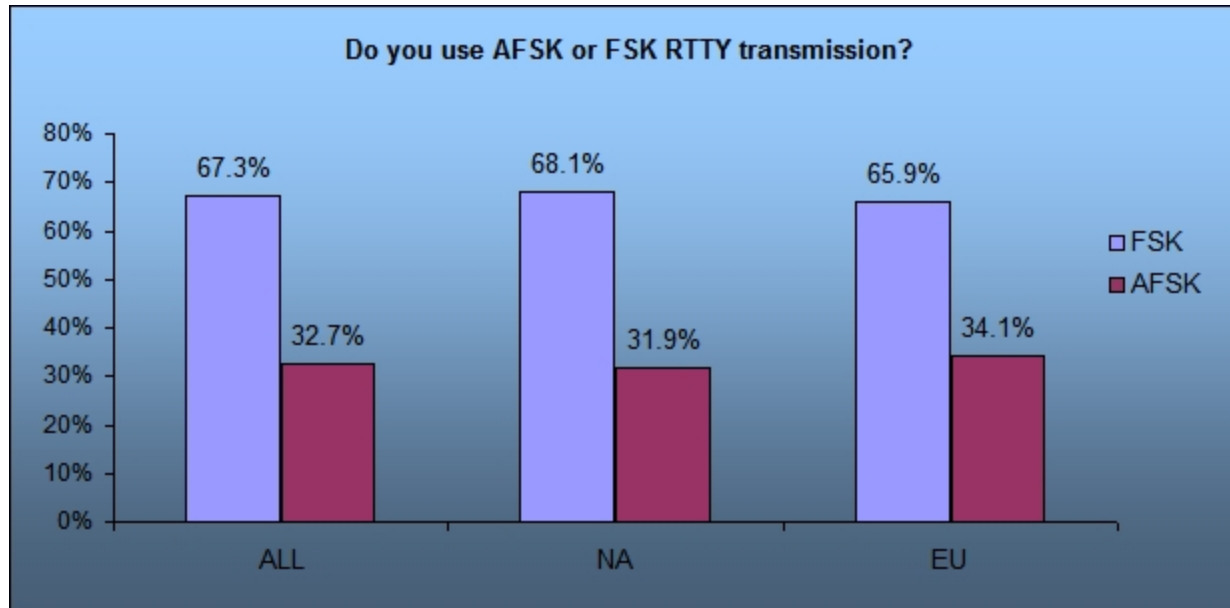
Two methods of transmission:

- AFSK (Audio Frequency Shift Keying)
 - keyed audio tones into SSB transmitter via:
 - Mic input, or
 - Auxiliary audio input. e.g., Line In
- FSK (Frequency Shift Keying)
 - keys the transmitter just like CW

Note: Receiving is the same in either case.

AFSK vs. FSK

2010 survey



- AFSK has been overtaken by FSK since it first appeared in radios, circa 1990

AFSK vs. FSK

comparison



AFSK

- Indirect (*tones → Mic input*)
- Any SSB radio (*esp. legacy*)
- SSB (wide) filtering
- Dial = sup. car. frequency
- VOX
- Audio cable (*same as PSK31*)
- Should use high tones
- NET (*automatic TX tone control for S&P*)
- Less bandwidth

Easy set-up; better signal; NET

FSK

- Direct (*like CW keying*)
- “Modern” radios
- RTTY (narrow) filtering
- Dial = Mark frequency
- PTT
- FSK keying hardware
- Can use low tones
- No audio level adjust
- No disabling speech proc.
- No erroneous sound keying

Less pitfalls

AFSK vs. FSK

dial frequency

spots are often wrong!



- RTTY RF is independent of local audio tones and whether LSB or USB is used:
 - The higher RF frequency is the Mark (*14090.000 kHz*)
 - The lower RF frequency is the Space (*14089.830 kHz*)
 - The difference between the two is the shift (*170 Hz*)
- FSK displays Mark (*14090.000 kHz*)
- AFSK displays suppressed carrier which varies with local audio tones and sideband used!
 - For Mark tone of 2125 Hz (Space tone of 2295 Hz):
 - LSB (*14092.125 kHz*)
 - USB – Mark & Space tones reversed (*14087.005 kHz*)

AFSK vs. FSK

which is “best”?

“Danger, Will Robinson, religious controversy ahead!”



- “AFSK often has poor signal quality, causing heavy QRM.”
- “FSK often has unnecessarily wide bandwidth, creating heavy QRM.”
- “AFSK is simpler.”
- “FSK is simpler.”

AFSK vs. FSK

which is “best”?

Answer: The one that best enables your success!



Two challenges:

- Transmission bandwidth, and
- Bit timing

RTTY Transmit Bandwidth



AFSK

- Use radio FSK filter
 - DSP TX filter (K3)
 - Lobby other mfrs
- Use MODEM TX filter
 - MMTTY 512-tap, not 48-tap default
 - 2Tone default
- Properly adjust
 - Level
 - Compression disabled

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FSK

- Use radio FSK filter
 - DSP TX filter (K3)
 - Lobby other mfrs
- Otherwise, use AFSK

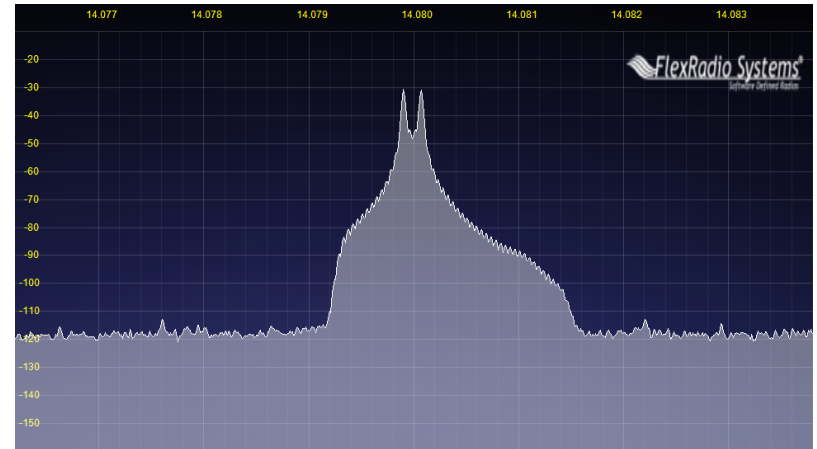
RTTY Radios

AFSK bandwidth



MMTTY - AFSK

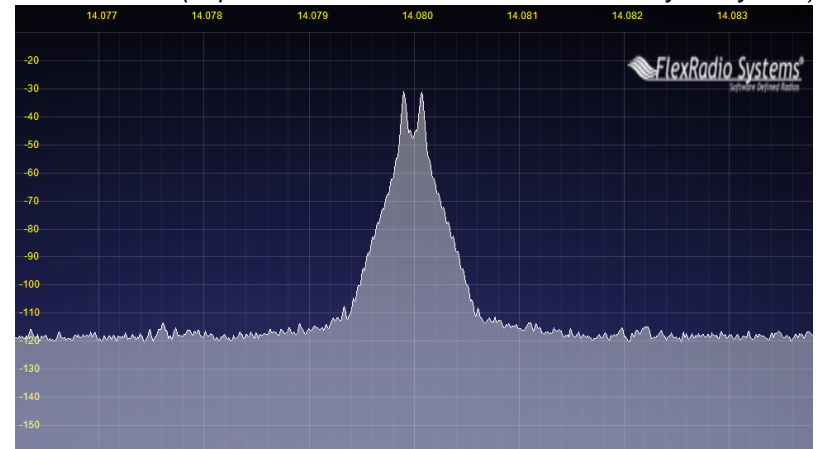
- No TX filter
- K3 @ 1 mW



Thanks K0SM (<http://www.frontiernet.net/~aflowes/k3rtty/k3rtty.html>)

MMTTY - AFSK

- Default 48-tap TX BPF
- K3 @ 1 mW



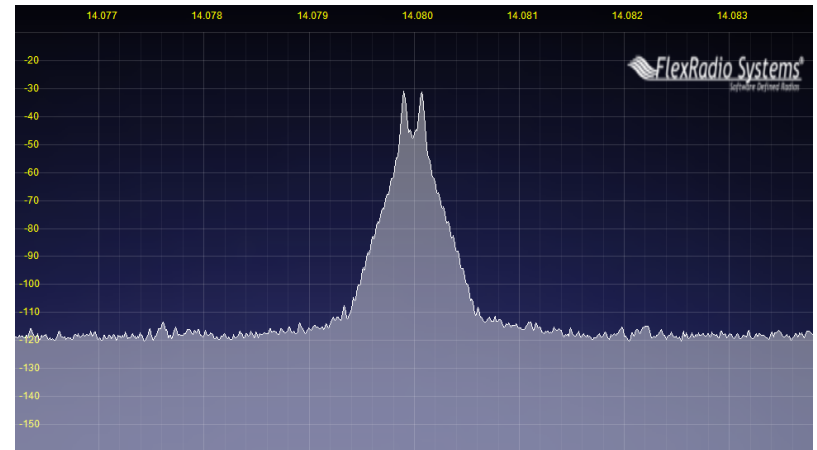
RTTY Radios

AFSK bandwidth



MMTTY - AFSK

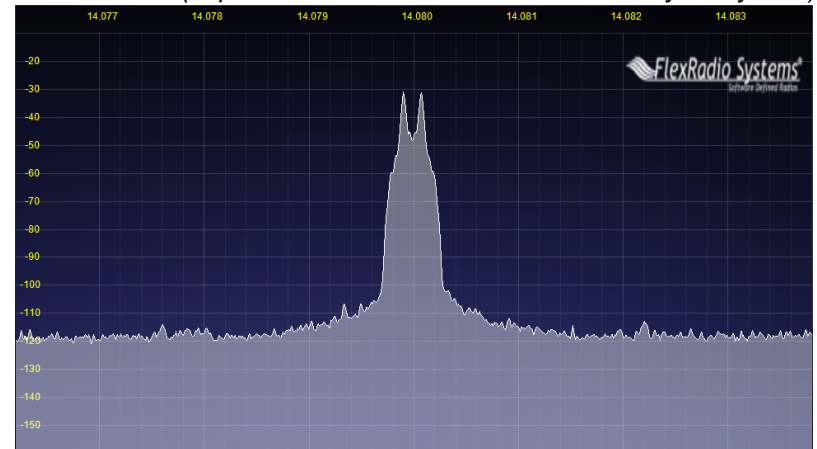
- Default 48-tap TX BPF
- K3 @ 1 mW



Thanks K0SM (<http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html>)

MMTTY - AFSK

- 512-tap TX BPF
- K3 @ 1 mW



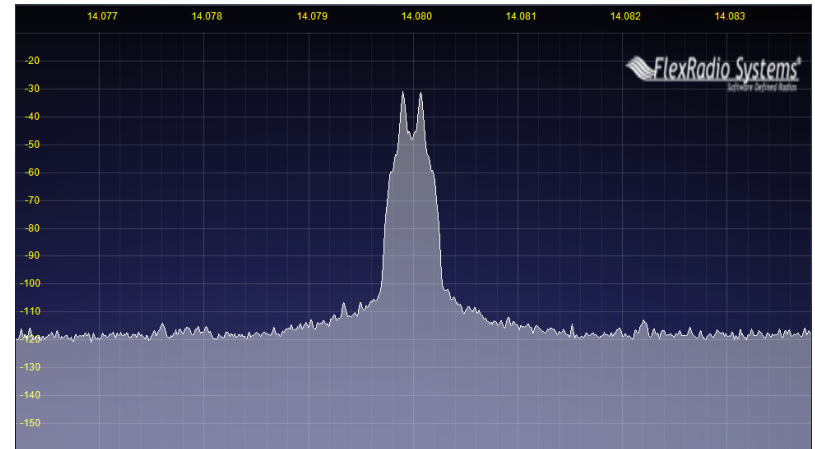
RTTY Radios

AFSK bandwidth



MMTTY - AFSK

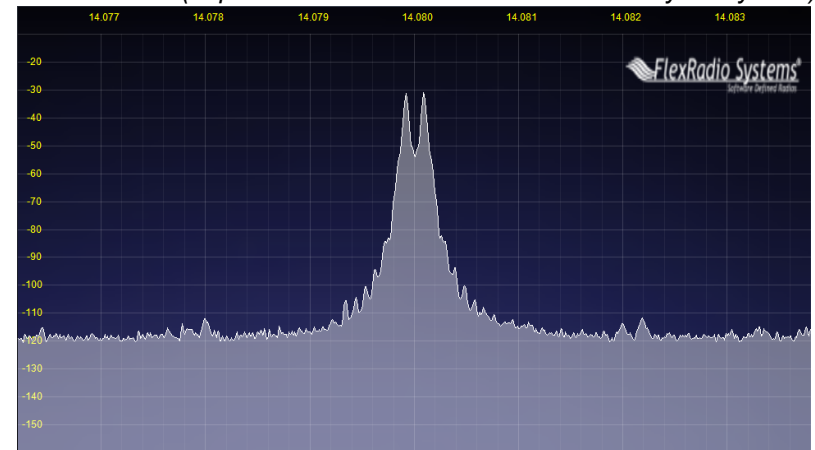
- 512-tap TX BPF
- K3 @ 1 mW



Thanks K0SM (<http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html>)

2Tone - AFSK

- Default “AM” setting
- K3 @ 1 mW



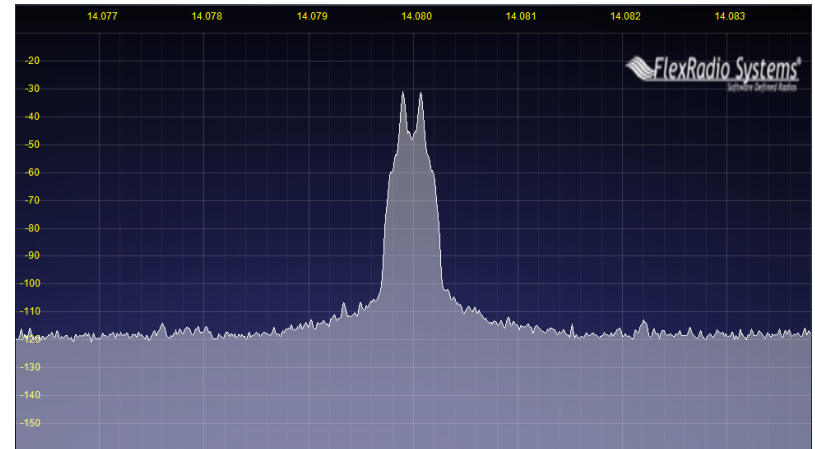
RTTY Radios

PA IMD impact on AFSK bandwidth



MMTTY - AFSK

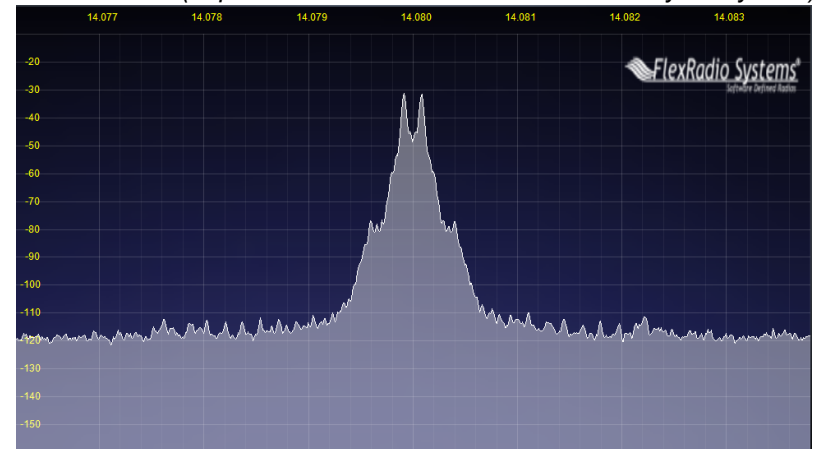
- 512-tap TX BPF
- K3 @ 1 mW



Thanks K0SM (<http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html>)

MMTTY - AFSK

- 512-tap TX BPF
- K3 @ 100 watts



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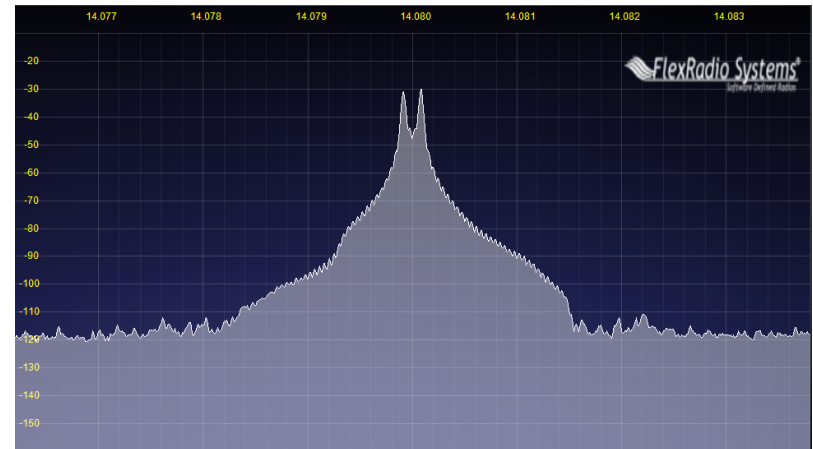
RTTY Radios

PA IMD impact on AFSK bandwidth



MMTTY - AFSK

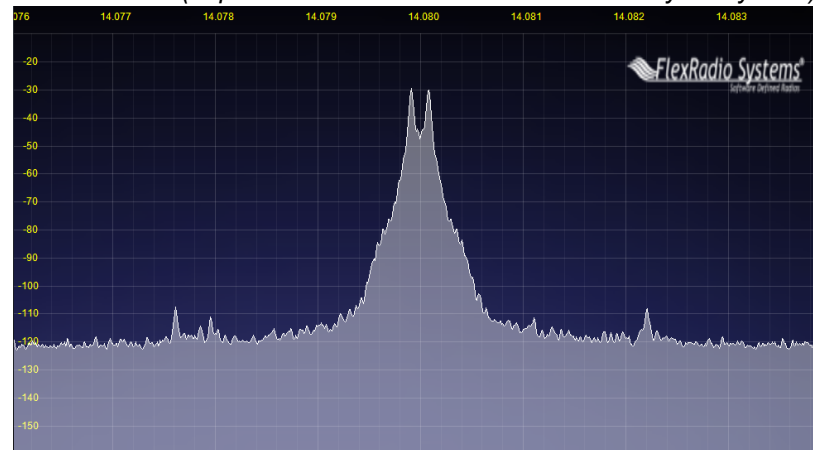
- No MMTTY filter
- No K3 AFSK filter
- K3 @ 100 watts



Thanks K0SM (<http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html>)

MMTTY - AFSK

- No MMTTY filter
- K3 AFSK filter
- K3 @ 100 watts



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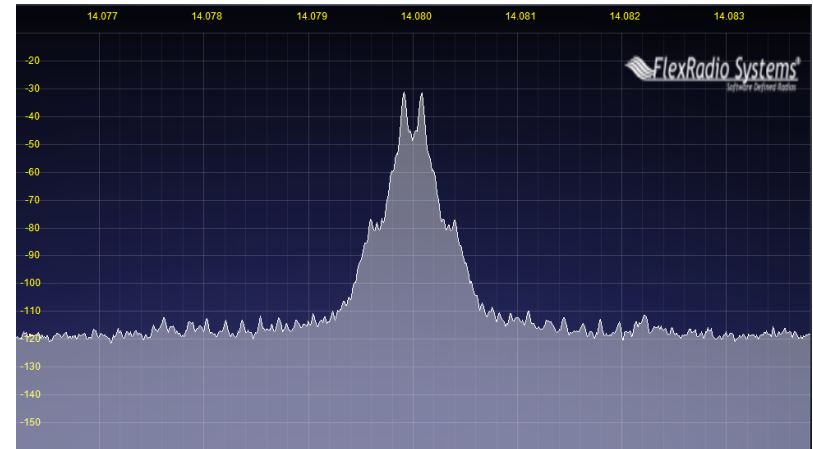
RTTY Radios

PA IMD impact on AFSK bandwidth



MMTTY - AFSK

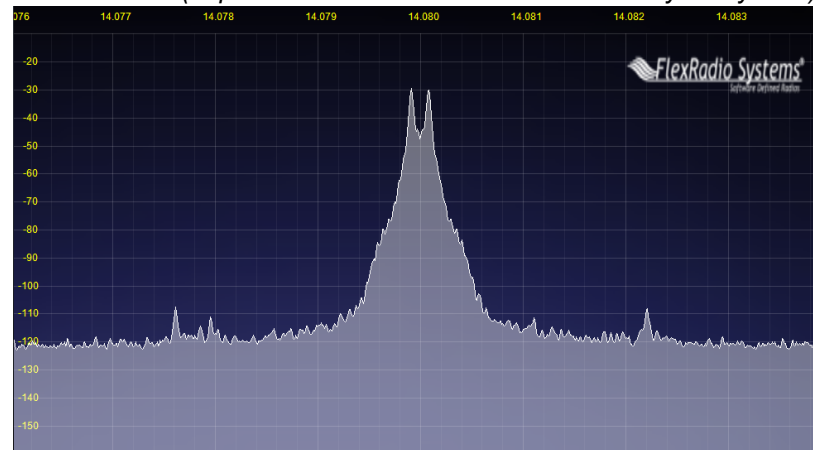
- 512-tap TX BPF
- No K3 AFSK filter
- K3 @ 100 watts



Thanks K0SM (<http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html>)

MMTTY - AFSK

- No MMTTY filter
- K3 AFSK filter
- K3 @ 100 watts



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RTTY Radios

PA IMD impact on RTTY bandwidth

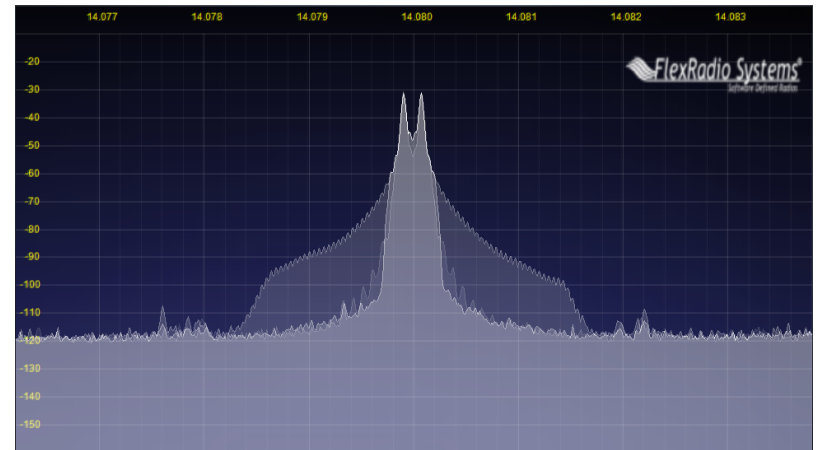


FSK/MMTTY/2Tone

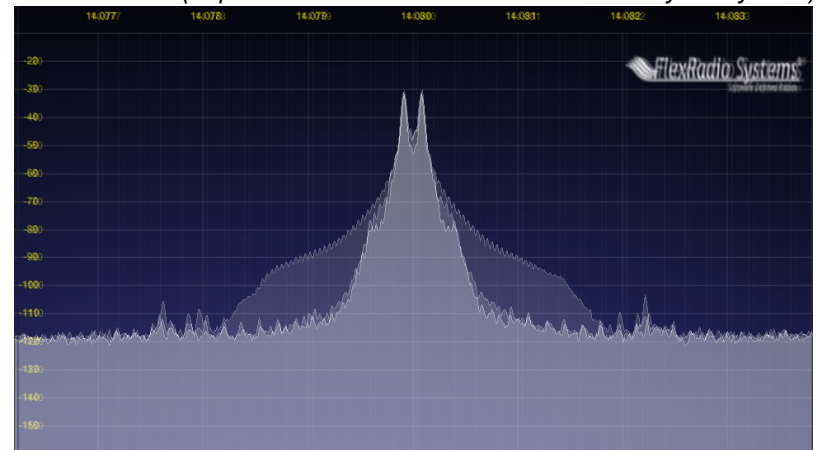
- FSK unfiltered
- MMTTY 512-tap BPF
- 2Tone “AM” setting
- K3 @ 1 mW

FSK/MMTTY/2Tone

- Same encoders
- K3 @ 100 watts



Thanks K0SM (<http://www.frontiernet.net/~aflowers/k3rtty/k3rtty.html>)



Thanks W7AY for composite graphics

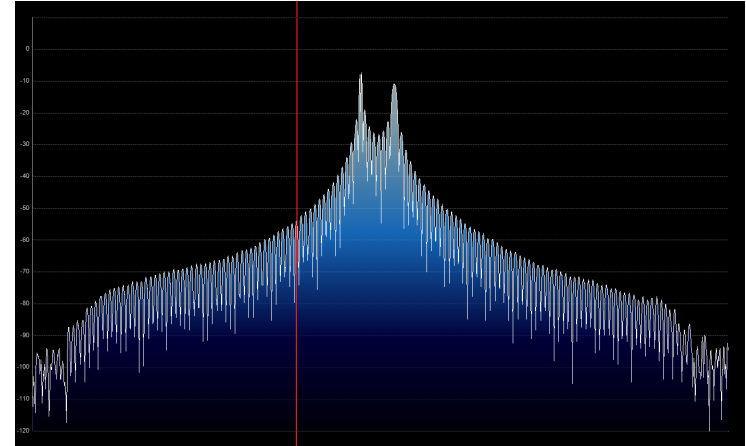
RTTY Radios



FSK bandwidth

Old K3 FSK bandwidth

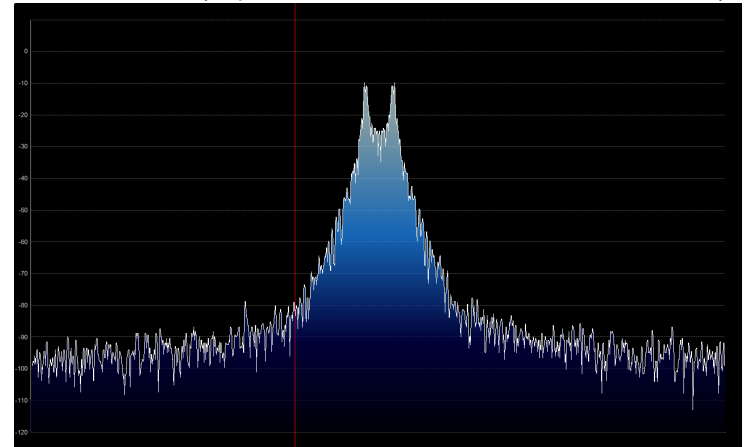
- No waveshaping
- < DSP281 firmware
- Typical of all radios
- 50 watts



Thanks K0SM (<http://www.frontiernet.net/~aflowers/k3beta/>)

New K3 FSK bandwidth

- Optimal DSP filter
- DSP281+ firmware
- Lobby other mfrs to add a FSK filter!



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AFSK Signal Quality

Operator Skill & Attention



- Speech compressor disabled
- Audio drive level below clipping
- RF amplifier drive level below hard limiting
 - Including change of operating frequency
- Elimination of ground loop hum
- Muting of Windows sounds

FSK Bit Timing

PC vs. dedicated timing



PC

- Stop Bit “jitter”
 - Varying Stop Bit length
 - Not nominal Stop Bit length
 - Not 45 vs. 45.45 Baud
- PC CPU speed vs. application demand
 - Quad-core, > 2 GHz
- USB loading
 - Minimize other USB
- System clock inaccuracy
 - Motherboard UART

Dedicated

- Bit timing outside PC
- TinyFSK
 - N1MM only
- rpiFSK
 - N1MM, WriteLog, WinWarbler, others

RTTY Decoders

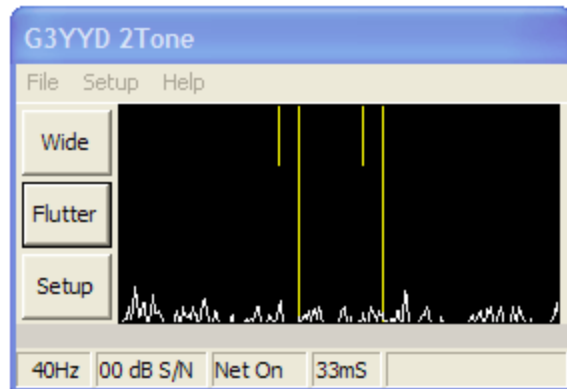
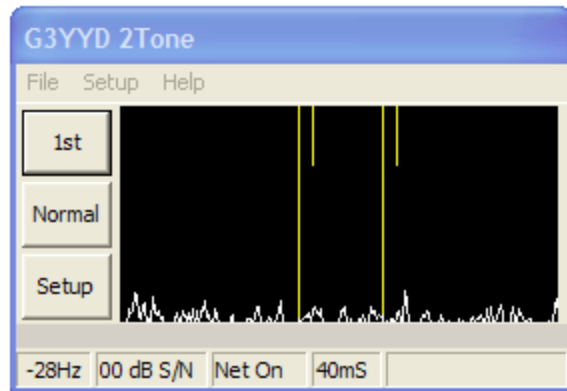
typically bundled with an encoder



- MMTTY
- 2Tone
- Other software: MMVARI, Fldigi, MixW, etc.
- Hardware TNCs:
 - Hal DXP38
 - Timewave PK-232
 - Kantronics KAM

RTTY Decoders

2Tone



- Outperforms MMTTY
- Uses less CPU cycles
- AFSK only
- Pseudo FSK
- Contest loggers:
 - N1MM Logger
 - WriteLog
- Introduced late 2012
- David Wicks, G3YYD

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Hardware TNCs

or “Modem”



Logger Support



- WriteLog
 - MMTTY, MMVARI, 2Tone
 - PCI-3000/4000, DSP-4100/DXP-38, P-38, PK-232, KAM, STS, KT4FY MM, dumb terminal
- N1MM Logger
 - MMTTY, MMVARI, 2Tone, Fldigi
 - DXP38
- Win-Test
 - MMTTY

Logger support

MMTTY & 2Tone



Feature	MMTTY		2Tone	
	AFSK	FSK	AFSK	FSK
WriteLog	😊	😊	😐	😊
N1MM Logger	😊	😊	😊	😊
Win-Test	😊	😊	😞	😞

😐 NET on

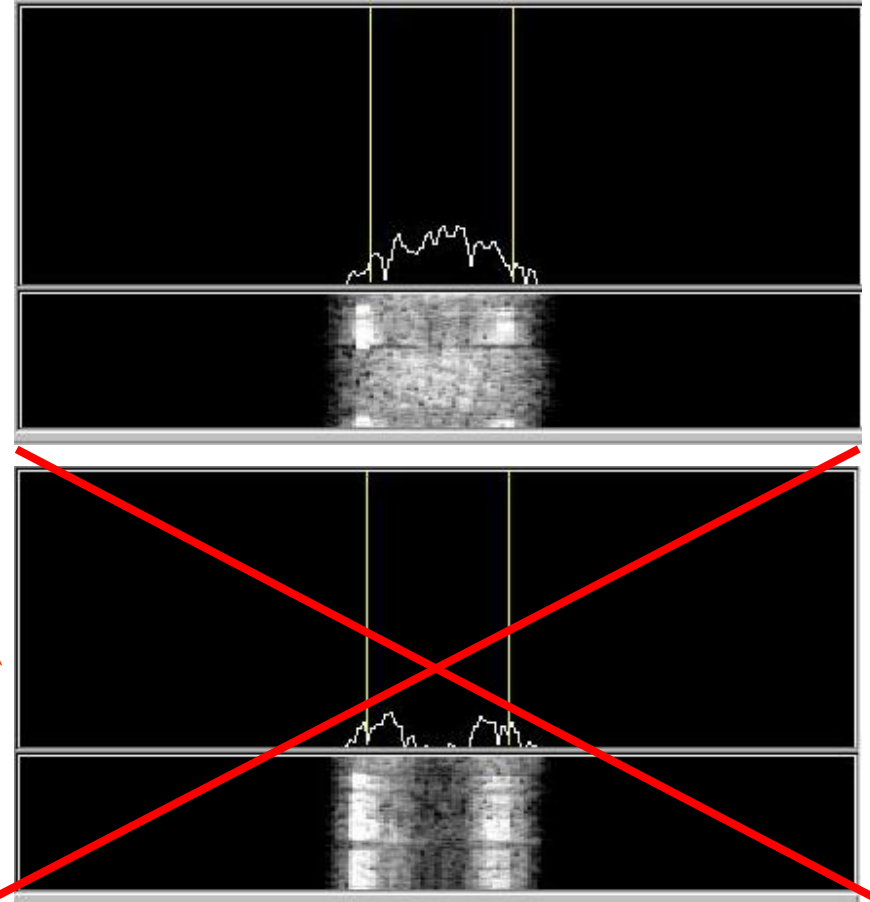
😞 not available

IF Bandwidth

optimal decoding



- Narrow IF filters (Roofing & DSP)
 - 400-500 Hz - normal
 - 250 Hz – “may help” with strong QRM
 - Tone filters – **don't use!**
 - Icom Twin Peak Filter
 - K3 Dual-Tone Filter
- Audio filtering
 - JPS NIR-10/12
 - Timewave DSP-599zx
 - Modern DSP rigs



RTTY Decoders

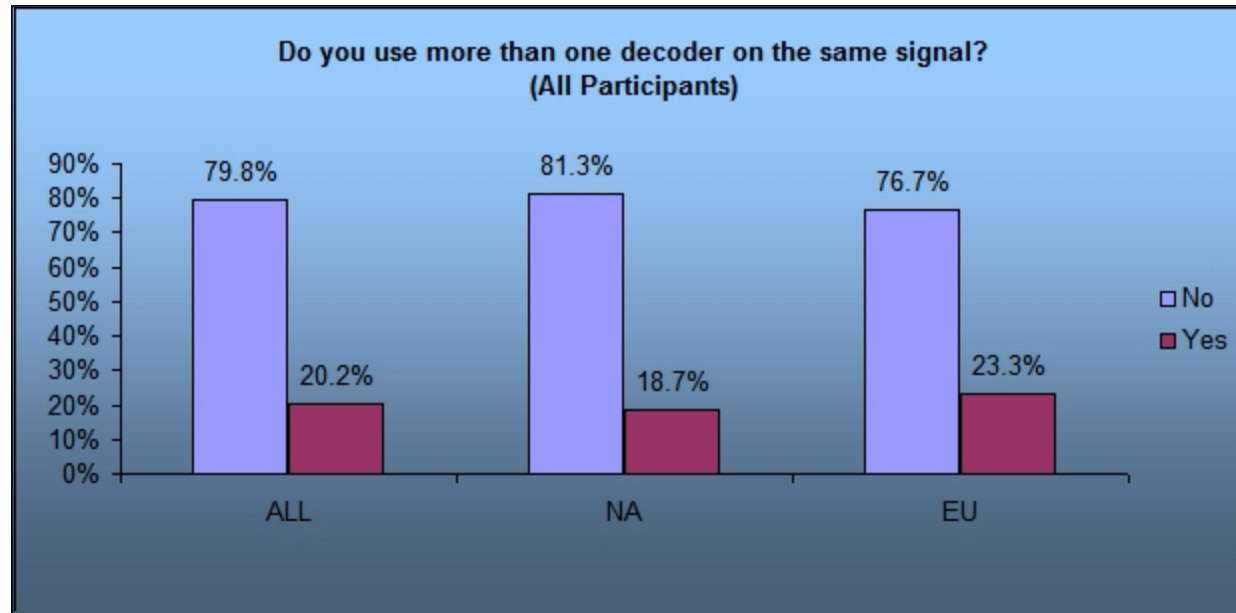
choice of Tones



- Less fatiguing
- Low/High tones can be mixed to put two audio streams in one ear:
 - SO2R plus SO2V per radio
 - SOnR

Multiple RTTY Decoders

2010 survey



- 20% use multiple decoders

Multiple RTTY Decoders

Why?



- Diversity of decoding algorithms
 - The more diversity, the closer to human brain
- Higher probability of clear print
 - All decoders equal 95% of the time
 - 1% of the time, only one will print clearly
 - Each of the them is the “winner” at some time
- Less wasted time asking for repeats
- Zero cost

- [illegible]

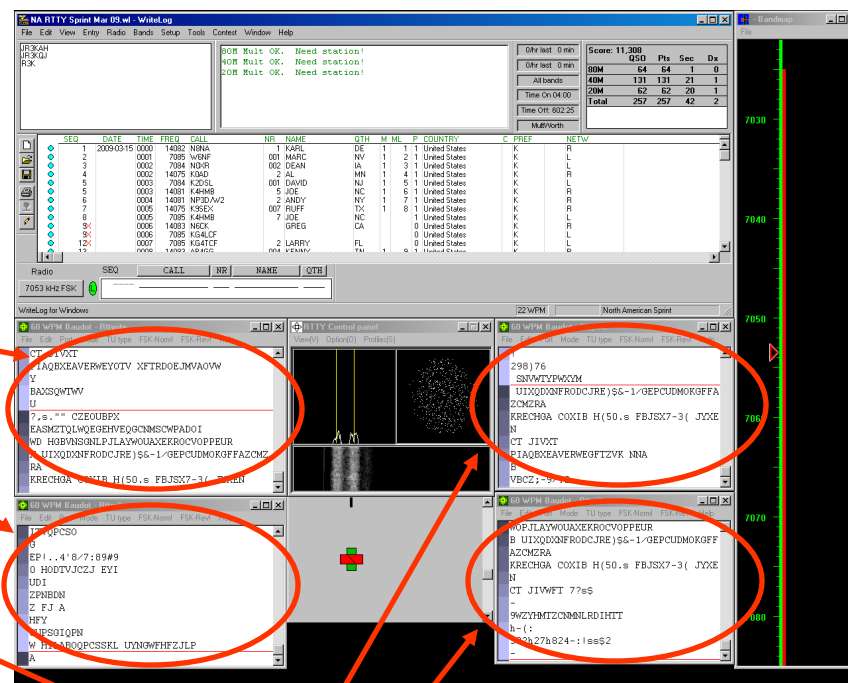
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Multiple RTTY Decoders

multiple MMTTY profile windows



- Parallel decoding
 - same audio stream
 - switching takes too long
- Multiple profile windows
 - Standard
 - Fluttered signals
 - Fluttered signals (FIR)
 - Multi-path
 - hyper sensitive
 - EU1SA
 - AA6YQ-FIR-512
 - weak signals in QRN

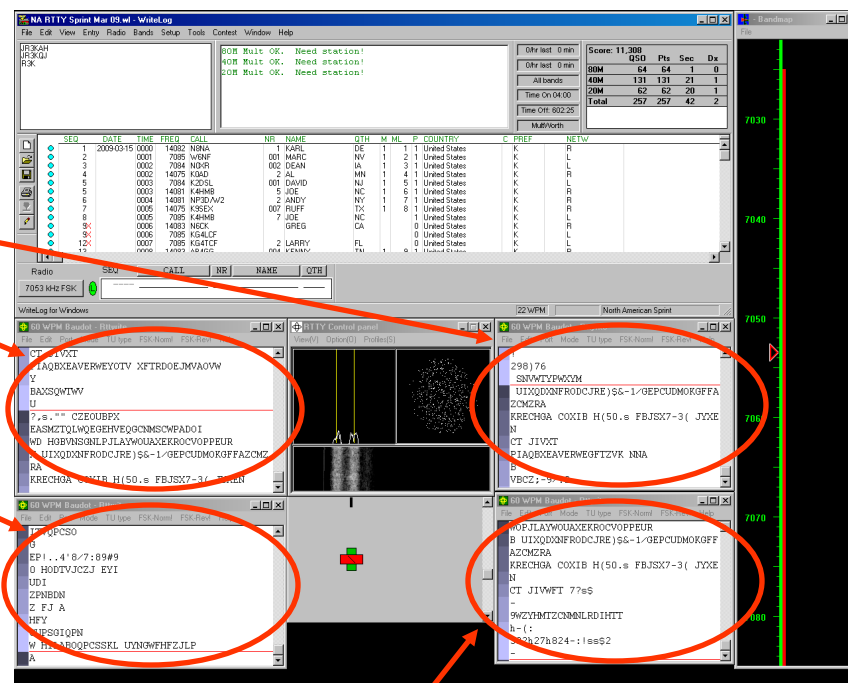


Multiple RTTY Decoders

two IF bandwidths



- Narrow IF filtering (main RX)
 - Hardware modem, i.e. DXP38
 - MMTTY profiles
 - Standard
 - Fluttered signals
 - Fluttered signals (FIR)
 - Multi-path
 - hyper sensitive
 - EU1SA
- Wide IF filtering (sub RX)
 - MMTTY profiles
 - AA6YQ-FIR-512
 - Dual Peak Filter
 - "Matched filter"



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Multiple RTTY Decoders

SO2V: 4 + 2 decoders



RX/TX

RX only

Main-RX
(2Tone Nor)

Main-RX
(2Tone Flutter)

Main-RX
(MMTTY Std)

Sub-RX
(2Tone Nor)

Sub-RX
(MMTTY Std)

Main-RX
(DXP-38)

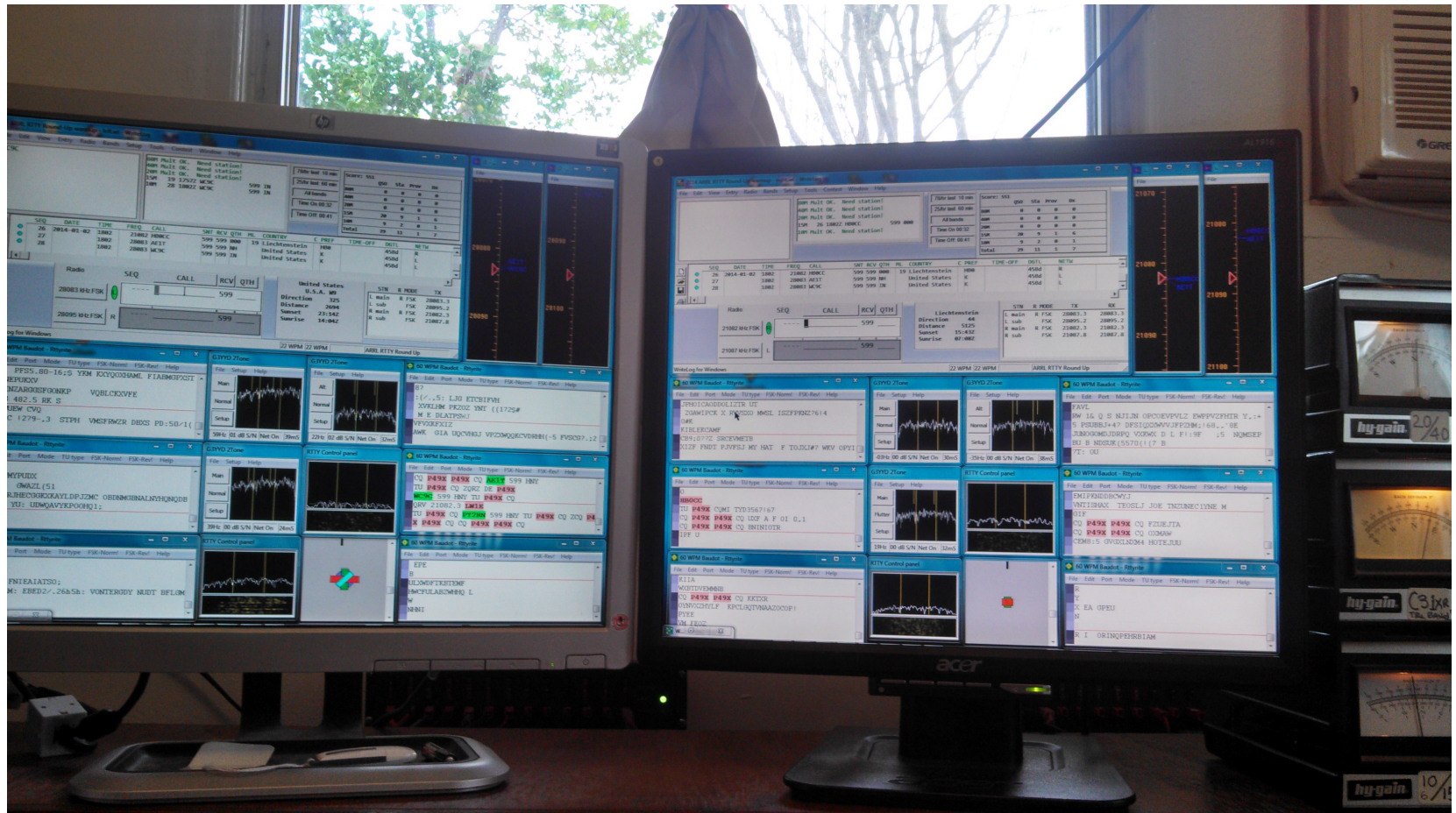


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Multiple RTTY Decoders

SO2R-SO2V: 2 x (4 + 2) decoders



Interfaces

AFSK & FSK keying



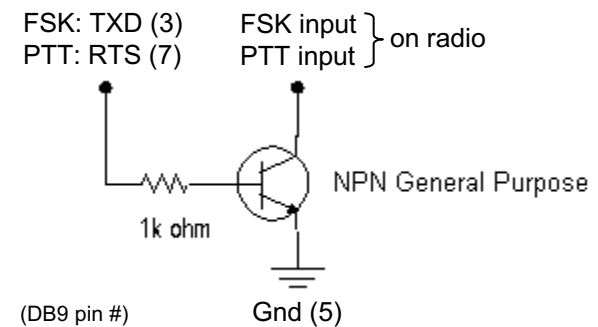
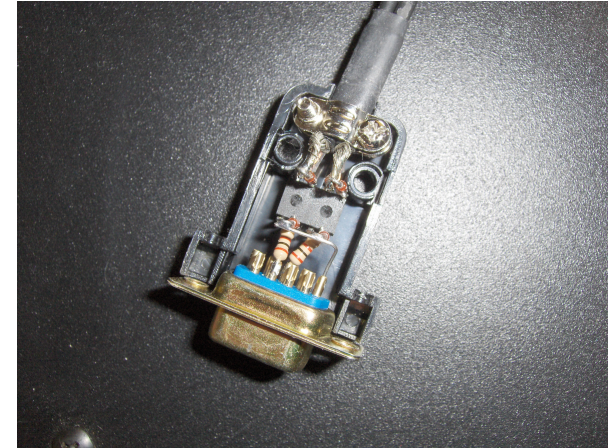
AFSK

- Standard audio cable
 - 3.5mm (SC) to ?? (radio)
- Optionally
 - Isolation transformer
 - 40 dB pad, if Mic input
 - Level control

FSK

- FSK/PTT keying cable
 - Homebrew
 - Commercial
- Optionally
 - USB-Serial adapter
 - Edgeport/4 or /8
 - “some” consumer units

Homebrew FSK/PTT cable

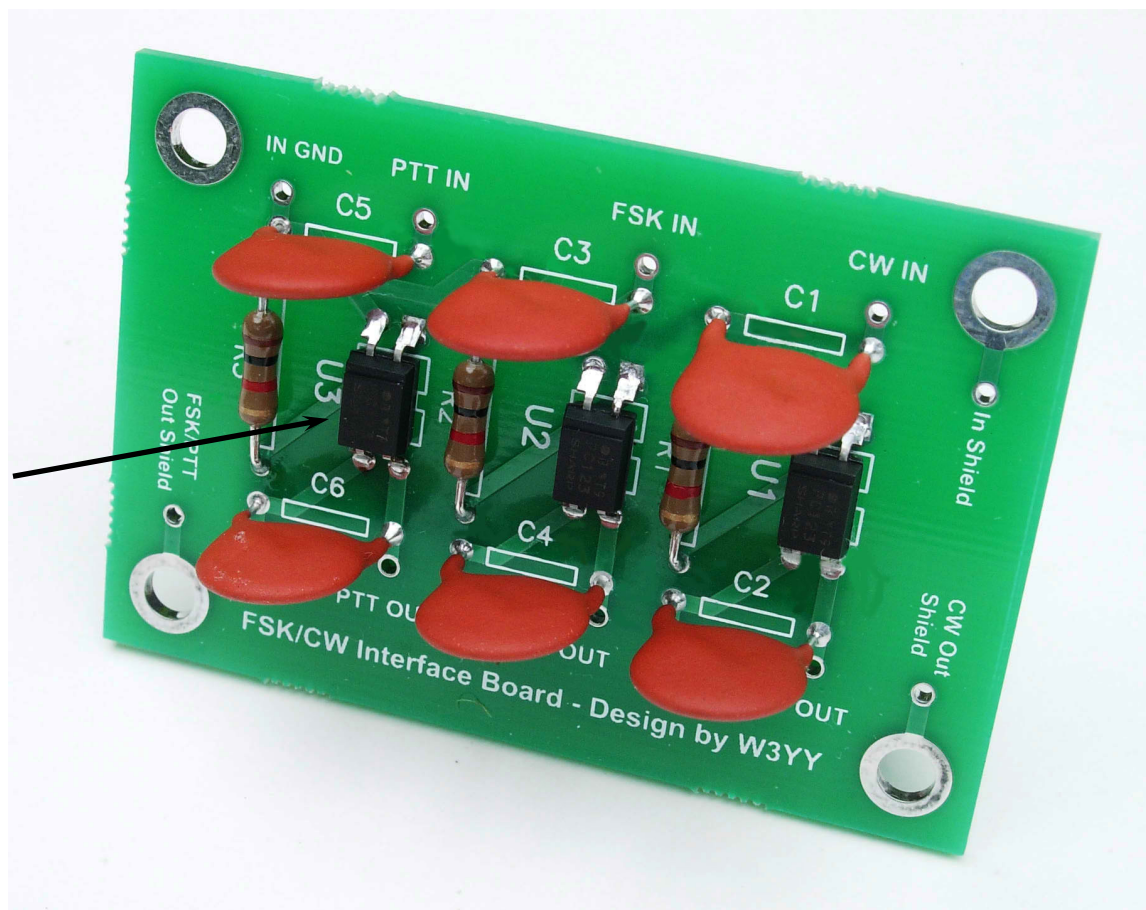


Homebrew FSK/PTT cable

commercial W3YY board



Opto-isolators



Commercial Interfaces

USB: TX/RX, isolation, level ctrl



RASCAL



RIGblasters



pro

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Commercial Interfaces

comparative choices



Vendor	Model	Price	PC In'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio in'fc
generic (with K3)	(2) 3.5mm M-M audio cables	\$ 10	-			√					
Buxcomm	Rascal-IIB or -IIIA	\$ 69	-								
Buxcomm	Rascal GLX	\$ 79	Serial	√							
Tigertronics	SL-1+	\$ 80	-	auto							
Tigertronics	USB	\$ 110	USB	auto	√	√					
MFJ	1273B	\$ 60	Serial	√							
MFJ	1275	\$ 110	Serial	√							
MFJ	1279	\$ 140	Serial	√	√						
Mountain Radio	RIGblaster Nomic	\$ 60	Serial/USB	√							
Mountain Radio	RIGblaster Plug & Play	\$ 120	USB	√				√			some
Mountain Radio	RIGblaster Plus II	\$ 160	USB	√			√ or CW	√ or FSK			some
Mountain Radio	RIGblaster Advantage	\$ 200	USB	√	√	√	√ or CW	√ or FSK			√
Mountain Radio	RIGblaster Pro	\$ 300	Serial/USB	√			√	√			√
Navigator	Navigator	\$ 417	USB	√	√	√	√	√	√		√

See May-June 2012 NCJ, "RTTY Contesting" column

Commercial Interfaces

RigExpert



Commercial Interfaces

microHAM



One Radio



SO2R



Commercial Interfaces

RigExpert & microHAM comparison



Vendor	Model	Price	PC In'fc	PTT	Soundcard	Level ctrl	FSK	CW	WinKey	Voice	Radio in'fc	SO2R
RigExpert	Tiny	\$ 120	USB	✓	✓			✓		✓	✓	
RigExpert	Standard	\$ 265	USB	✓	✓	✓	✓	✓	✓	✓	✓	
RigExpert	TI-5	\$ 365	USB	✓	✓	✓	✓	✓	✓	✓	✓	
microHAM	USB Interface II	\$ 179	USB	✓				✓			✓	
microHAM	USB Interface III	\$ 225	USB	✓	✓	✓		✓			✓	
microHAM	Digi KEYER II	\$ 369	USB	✓	✓	✓	✓	✓	✓		✓	
microHAM	microKEYER II	\$ 479	USB	✓	✓	✓	✓	✓	✓	✓	✓	
microHAM	micro2R	\$ 369	USB	✓		✓	✓	✓	✓	✓	✓	✓
microHAM	MK2R	\$ 899	USB	✓		✓	✓	✓	✓	✓	✓	✓
microHAM	MK2R+	\$ 999	USB	✓	✓	✓	✓	✓	✓	✓	✓	✓

See May-June 2012 NCJ, "RTTY Contesting" column

Resources



- NCJ RTTY Contesting columns
 - Decoding: Jul/Aug 2013 and Jan/Feb 2014
 - Commercial RTTY interfaces: May/Jun 2012
- Prior CTU RTTY presentations
 - 2014 CTU textbook from DXE (\$19.95)
- AA5AU website: www.rttycontesting.com
 - Tutorials and resources (beginner to expert)
 - WriteLog/N1MM Logger and MMTTY/2Tone
- Email reflector: rtty@contesting.com
 - RTTY contester networking
 - Q&A

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